6.0 EQUIPMENT REMOVAL EVALUATION

6.1 JUSTIFICATION

One of the primary objectives of this investigation was to determine whether the PCB containing items should be removed, when they should be removed and what types of “best engineering practices” could be employed to minimize the risks to the environment. The conceptual site model developed from this data indicates that the electrical items are a continuing source of PCBs in the environment. This has lead to the conclusion that leaving the equipment in the river poses a greater threat to the environment than removing them and also to the determination that the items should be removed as soon as possible. The following sections describe a removal plan that is based on earlier work as well as on this data and develop a preliminary ecological risk screening for the removal action.

6.2 CONCEPTUAL REMOVAL PLAN

Several removal options were considered for removal of the electrical equipment, including an isolation cofferdam and excavation; mechanical dredging; and a diver-assisted removal. The proposed removal plan is a diver-assisted equipment removal. This method is preferred for the following reasons:

- Timing - it can be conducted within the current fish window.
- Proven effectiveness – the same approach worked well in December 2000.
- Size of the project – the volume of waste (313 cubic yards) is relatively small and a good portion of the waste is non-PCB containing, therefore a simple and straightforward approach is warranted.
- Minimal adverse environmental risk – short-term increased exposure; little impacted sediment is present to entrain into the water column.
- Implementability– other techniques would require detailed designs, more equipment, and more time to perform.

The waste-related items will be removed from the three distinct near-shore areas identified during the investigation. Additional electrical components located within these three general areas, and any other components discovered, will be located and recovered. A diver will attach a recovery line to each item and a crane mounted on a barge will raise the items to the surface. Once at the surface, each item will be placed into a containment area on the barge.

During the recovery operation, a full depth turbidity screen will be installed and anchored in-place around the work area and will remain in place following recovery to allow for settling of suspended sediments. The screen type will likely consist of a nonwoven permeable fabric and be ballasted to maintain contact with the river bottom. A recent pilot study completed by URS at a former U.S. Steel facility (Shearwater site) in San Francisco Bay, California indicated that these fabrics greatly reduce turbidity from dredging outside the protective screen. In one case the turbidity inside the screen was greater than 350 NTU while the turbidity outside the screen was just above background (12 NTU). Since the majority of the PCBs are associated with the particulate component (i.e. turbidity), containment of the turbid water minimizes exposure and risk. For this project, the turbidity screen will remain in-place following removal activities until the sediment entrained in the water column during operations settles as indicated by turbidity monitoring data.

Real-time turbidity monitoring will be implemented before, during and after equipment removal at regularly scheduled intervals, and at stations upstream and downstream at the river surface, at multiple depths. Visual observations for surface sheen or plumes will also be conducted. Action levels will be developed prior to implementation, and removal activities will be stopped if monitoring indicates an exceedance.

6.3 PRELIMINARY ECOLOGICAL RISK SCREENING

6.3.1 Expected Concentrations and Toxicity

Adverse effects to biota during the removal process may occur in two ways: direct toxicity to benthic and aquatic invertebrates and fish that may be exposed to residual PCBs in the sediments and water column and bioaccumulation-related impacts to other biota that may consume these invertebrates. The transport mechanisms for PCBs during the removal would be: resuspension of the sediment particulates into the water column; partitioning from the particulate component to the dissolved component; further partitioning from the dissolved component to dissolved organic carbon (DOC) present in the water column; and transport of these components by river currents.

Detected PCBs in the dissolved phase were quantified as Aroclor 1254 during the diver-assisted resuspension study. The maximum measured concentration was 0.265 μg/L. The average concentration from all samples (excluding the Goose Island sample and applying one-half the detection limit for the one ND observation) was 0.069 μg/L. The average value is more representative of the potential concentrations in water during removal operations since it integrates the characteristics of all the debris piles. The particulate phase concentration was measured at a maximum of 7.28 μg/L and an average of 1.66 μg/L.

These measured concentrations in water are likely to overestimate the bioavailable concentration for aquatic biota for several reasons:

1) For molecules of large size such as more heavily chlorinated PCB congeners, molecular volume, lipid solubility and steric hindrance are all-important aspects, which regulate and limit the bioavailability of PCBs and their ability to pass through biological membranes. The ability of the less heavily chlorinated PCBs to bioaccumulate is reduced by sorption of less heavily chlorinated PCB congeners with dissolved organic carbon in water. DOC was not measured during the in-water investigation; its potential to reduce the bioavailability of PCBs is therefore unknown.

2) The highest PCB concentration would occur near the equipment being removed, and if a turbidity screen were placed around the area it would occur within the work area and would include both the soluble and the particulate-associated fractions. PCB concentrations outside the work area would be initially limited to the soluble phase. Dissolved concentrations would eventually be reduced due to the effects of adsorption onto particulate matter in the water column, and to the effects of mixing and dilution.

3) The dissolved phase PCB concentration will decrease as the concentrations are diluted in the river. Using the experimentally determined average dissolved water concentrations of 0.069 µg/L and a simple dilution calculation, the dissolved water concentration is estimated to be below the AWQC CCC (see Section 4.2 for additional discussion about the use of the benchmarks) within approximately 100 feet of the work area. In addition, it is expected that a portion of the dissolved PCBs may become sorbed to the turbidity screen fabric, thereby helping to lower the concentration of dissolved PCBs in the water column outside of the screen.

4) The exposure duration for elevated concentrations of PCBs in the water column is temporary and of limited duration (approximately 2 weeks). Therefore, the potential for increased exposure to aquatic receptors is also short-term and limited.

As stated above, concentrations of PCBs in water outside the work area are expected to be substantially lower than inside the work area. It is, in fact, likely that PCB concentrations in water outside the turbidity screen may be below detection limits. The potential exposure duration for aquatic invertebrates and fish is also likely to be more transitory due to their freedom of mobility outside the work area. As noted above, the potential average and maximum water soluble PCB levels within the work area are well below the LOEC values for invertebrates and fish. This is also true outside the work area where the PCB concentrations would be lower. Because of the expected decrease in PCB concentrations outside the work area, it is unlikely that the AWQC will be exceeded outside the work area. Furthermore the dissolved phase concentration would be diluted (see above). Therefore, toxicity to aquatic invertebrates and fish outside the work area due to increased PCB concentrations in the water column during removal is highly unlikely and not expected to occur.

A search of USEPA's aquatic toxicity database (AQUIRE) was conducted to identify more definitive sources of information for No Effects Concentrations (NOEC) and Lowest Observed Effects concentrations (LOEC) for test species that would be relevant to the project site. The lowest LOEC reported for a sub-lethal endpoint in freshwater invertebrates was the EC50 (50^{th} percentile effects concentration) for reproductive effects seen in the water flea (*Daphnia magna*) at 1.1 µg/L for a 14-day exposure to Aroclor 1254 (Nebeke, 1974). Among freshwater fish, effects on growth were seen in the Coho salmon (*Onchorhynchus kisutch*) at 7.8 µg/L following a 14-day exposure period (Halter, 1974). The conservatively estimated soluble concentrations of PCBs (both maximum and average) within the recommended removal action work area are well below these LOEC levels. Therefore, the temporary and spatially limited exposure of aquatic biota within the work area to PCBs that may be solubilized during the removal are not expected to cause adverse effects to aquatic biota through the mechanism of toxicity due to direct exposure.

6.3.2 Indirect Exposure and Bioaccumulation-Related Toxicity

Bioaccumulation is the process by which chemicals accumulate in biological tissues at concentrations that are higher than in the surrounding environment. Biomagnification is the process by which chemical concentrations in biota increase with increasing (e.g. higher) trophic status of the biota. PCBs, by virtue of their hydrophobic and lipophilic nature and persistence, bioaccumulate in the fatty tissue of biological organisms. PCBs are also one of the few chemicals documented to biomagnify in aquatic food webs. PCB levels in tissue generally increase with age, size and lipid content of the biota. Estimating (as opposed to measuring) the concentration of PCBs in tissues implies a certain steady state equilibrium between the abiotic and biotic media. The PCB equipment removal is proposed during an environmental window when anadromous fish and fish of high ecological or recreational value would be absent. Therefore, the potential for increased human health risks for anglers due to in water removal activity is low or absent.

The only fish that may be present and exposed to PCBs in water during removal activities would be resident fish. It is difficult to estimate the potential incremental increase in invertebrate or fish tissue concentrations of PCBs due to increased water column concentrations of PCBs for a period of 2 weeks and the subsequent increased risk to predators that may consume them. Aquatic biota that may accumulate increased PCBs during this period would most likely be confined within the work area and may or may not survive the effects of increased turbidity or other physical habitat disruption during equipment removal activities. Even if they survive the work period and escape into the free water column, it is unlikely that these fish would comprise the only food source for any piscivorous receptor such as cormorants, bald eagles or river otters (all of which may occur in the area).

Aquatic biota outside the work area will be exposed to lower dissolved PCB concentration, therefore they will likely bioaccumulate PCBs to a lesser degree. The SPMD data indicated no detectable concentrations of PCBs in the water column over a period of 47 days. Therefore, bioaccumulation in fish tissues due to dissolved PCBs in water is expected to be low or below detection. As a preliminary screening level comparison, the potential increase in fish tissue concentrations of PCBs was estimated by assuming 14 days of exposure for a resident fish (either white sturgeon and walleye which are both sought after game fish) in the area that has an average life span of 3 years. By applying USEPA's bioconcentration factor for PCBs in fish (31,200) given in the 1980 ambient water quality criterion document for PCB to the average measured soluble PCB concentration (0.069 μg/L), the concentration increase in fish due to remedial activity was estimated as 27 μg/kg (whole body). This is in addition to the PCB concentration already in fish resident in the vicinity of Bradford Island. The increased risk to the fish itself, and any wildlife consumers of fish from a 27 μg/kg increase in tissue residues would be an incremental risk above any risk already present from the existing body burdens of PCB. The estimated 27 μg/kg increase in PCB concentrations may in itself overestimate the increase in

PCB tissue residues due to a temporary increase in waterborne PCB concentrations. This is because the time for waterborne PCB to reach steady state normally exceeds 14 days in fish. The estimated site related PCB increase in fish tissues due to equipment removal is well below the Great Lakes screening value of 100 µg/kg in fish tissue for the protection of aquatic wildlife, including birds, mammals and carnivorous fish. Therefore, it is unlikely that that there could be any increased risks to human or ecological receptors due to food web-mediated exposure to PCBs as a result of the in-water removal activities.

6.3.3 Toxicity to Benthic Invertebrates

Since this is an ongoing source and risk, the magnitude of this risk is not expected to increase due to the removal of electrical equipment. Rather, the risks would be ultimately be reduced, although not eliminated, by the removal of the continuing source of PCBs represented by the electrical equipment.

Residual concentrations in sediments are likely to exceed commonly used screening values for PCBs in sediments in the immediate area of the debris piles. However, this represents no change from current conditions. The elevated concentrations of PCBs measured in the crayfish and clams from within the debris piles would be expected to remain the same or decrease after removal of the piles and the continuing source of PCBs that they represent. Therefore, exposure of benthic biota to residual PCBs in the sediment would be no greater, and eventually lower than under current conditions. It is also unlikely that there would be any increase in exposure or dose for receptors that may feed on these benthic biota (e.g., diving birds). As seen in the videotape from the in-water investigation, shellfish and crayfish are distributed in large areas of the riverbed and were present in areas both inside and outside the debris piles. The proposed work area is small compared to the home range of mammalian and avian consumers of benthic species (although it is large compared to the home range of benthic species with limited or no mobility). Therefore, uncovering of sediments and associated benthos by removal of the electrical equipment would not represent a significant new food source for bottom feeders and divers and is not likely to lead to significantly increased risk for these receptors.

6.3.4 Potential Adverse Effects

The potential adverse effects associated with PCBs during the in-water removal of electrical equipment may be summarized as follows:

a) Toxicity due to direct exposure of aquatic invertebrates and fish within the work area to dissolved and particulate phase PCBs.

b) Toxicity due to direct exposure of aquatic invertebrates and fish outside the work area (i.e. outside the turbidity screens) to soluble phase PCBs.

c) Indirect exposure and bioaccumulation-related toxicity to semi-aquatic birds, mammals and predatory fish that may consume aquatic invertebrates and fish containing PCBs in their tissues.

d) Toxicity to benthic aquatic invertebrates that may be exposed to residual PCBs in the sediments and bioaccumulation-related impacts to other biota that may consume these invertebrates.